NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

BUILDING ENVELOPE IMPROVEMENT

(No.)

CODE 672

DEFINITION

Modification or retrofit of the building envelope of an existing agricultural structure.

PURPOSE

This practice may be applied to reduce energy use by regulating heat transfer.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any agricultural facility which is climate controlled at least part of the time with a completed energy analysis that complies with the guidelines for a Type 2 on-farm energy audit per the American Society of Agricultural and Biological Engineers (ASABE) S612. The audit will have, at a minimum, addressed the major activities of ventilation, air-heating, and air-cooling that exist in the building.

This practice does not apply to Seasonal High Tunnels.

CRITERIA

General Criteria Applicable to All Purposes

Implement recommendations of the Type 2 On-Farm Energy audit as they pertain to building envelope improvement.

Seal cracks with an appropriate sealant according to audit recommendations. Refer to the *American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) Handbook - Fundamentals* for appropriate sealant material and application methods.

Ensure the building envelope meets all applicable building codes. Ensure that U values of the improved walls and ceiling of the building envelope are equal to or less than the U values provided in Table 1 and Figure 1 of ASABE ANSI/ASAE S401.2, *Guidelines for Use of Thermal Insulation in Agricultural Buildings*.

Insulation and Vapor Retarders. Select insulation material based on temperature extremes, moisture conditions in the building, and expected UV light exposure.

Select insulation or covering materials that are durable, moisture resistant, non-toxic to humans or livestock, and consistent with applicable Federal Drug Administration regulations. Provide a means of insect control where needed.

Ensure insulation materials and vapor retarders exposed to the interior of the building will meet specifications described in ANSI/ASABE S401.2.

Insulation materials not meeting the requirements specified in the above paragraph and any insulation materials located directly adjacent to electrical panels, devices, and welding operations must be separated from the interior of the building by an ignition or thermal barrier in accordance with ANSI/ASABE S401.2.

Insulation must be compatible with electrical wiring of the structure.

Install insulation according to manufacturer's recommendations and in a manner that will maintain the thermal properties of the insulation.

Install insulation so that a reasonably uniform insulation value exists over the entire insulated area.

Install a vapor retarder with the insulation that provides a permanent resistance to water vapor of 14.3 ng/Pa-s-m2 (0.25 US perms) or less when installed. Evaluate and install the vapor retarder in accordance with the latest edition of *ASHRAE Handbook - Fundamentals*.

Commercial Doors and Windows. Windows and doors installed to improve building envelope efficiency shall be labeled in accordance with US Environmental Protection Agency (USEPA) Energy Star or shall meet the minimum requirements of the International Code Council (ICC) and the International Energy Conservation Code (IECC). Install doors, windows, and skylights in accordance with manufacturer's instructions and recommendations based on the minimum requirements set forth in ASTM E2112.

Note: Specific programs may dictate criteria in addition to, or more restrictive than, those specified in this standard.

CONSIDERATIONS

Choose and install insulation material to discourage entrance and chewing by rodents, pecking by birds, infestation by insects, or damage by livestock.

Buildings with general public access, such as retail spaces, may require more stringent building codes.

It may be necessary to move or modify electrical wiring, water pipes, fuel supply pipes, light fixtures, or other infrastructure for installation of the practice.

Automatic temperature and/or moisture sensors and controls can improve the efficiency of moveable greenhouse screens.

Where relative humidity within the agricultural building is maintained above 85%, refer to ASAE EP475 or other appropriate guidelines.

Tinted windows may be used in some cases to control building temperature. Tinting has no effect on the U-factor of a window, but it reduces solar gain. This may be a benefit in the summer and a liability in the winter, depending on local climate conditions.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared in accordance with the previously listed criteria. Plans and specifications shall contain sufficient detail to ensure successful implementation of this practice, and may be recorded in narrative form, on worksheets, or other approved forms.

The following components shall be included in the energy plan:

1. Plan drawing and description of the existing building envelope, and the modified or retrofitted building envelope and related components or devices, if applicable;

2. Description and characteristics of materials to be applied to the building envelope;

3. Details of ventilation and sealing provisions associated with the practice;

4. Requirements for disposal of replaced materials, if applicable;

5. Documentation requirements to determine energy savings associated with practice installation based on current heating/cooling requirements of the agricultural building.

OPERATION AND MAINTENANCE

An Operation and Maintenance (O&M) plan must be prepared, reviewed, is the responsibility of the client to implement. The O&M Plan shall provide specific instructions for proper operation and maintenance of each component of this practice and shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

At a minimum, the following components shall be addressed in the O&M plan, as applicable:

1. Check for leaks in the building envelope, especially along edges of energy screen seals;

2. Regularly inspect insulation to ensure it evenly covers building envelope spaces, and repair damaged material and components as necessary;

3. Periodically check for tears, and repair or replace torn vapor barrier or energy screen material;

4. Identify critical control devices associated with the building envelope system. Inspect regularly and perform maintenance as necessary.

SUPPORTING DATA AND DOCUMENTATION

The following is a list of the minimum data and documentation to be recorded in the case file:

1. Location of the practice on the conservation plan map;

2. Assistance notes. The notes shall include dates of site visits, name or initials of the person who made the visit, specifics as to alternatives discussed, decisions made, and by whom;

3. An energy audit developed by a qualified technical service provider and accepted by NRCS, or results of the Type 2 On-Farm Energy Audit conducted as per the American Society of Agricultural and Biological Engineers (ASABE) S612;

4. Approved engineering plans;

5. As-built documentation certifying the installation of planned practices. Photo-graphs, receipts, packaging or other documen tation of compliance with specifications. Signature of licensed electrician where applicable.

REFERENCES

1. American Society of Heating, Refrigeration and Air Conditioning Engineers. 2010. *ASHRAE Handbook – Fundamentals*.

2. American Society of Agricultural and Biological Engineers. 2011. *Design and Management of Storages for Bulk, Fall-Crop, Irish Potatoes.* ASAE EP475.1 JUN1996 (R2011). St. Joseph, MI.

3. American Society of Agricultural and Biological Engineers. *Guidelines for the Use of Thermal Insulation in Agricultural Buildings.* ANSI/ASABE S401.2 Feb. 1993 (R2008). St. Joseph, MI.

4. American Society of Agricultural and Biological Engineers. 2008. *Heating, Ventilating and Cooling Greenhouses.* ANSI/ASAE EP 406.4 Jan 2003 (R2008). St. Joseph, MI.

5. American Society of Agricultural and Biological Engineers. 2009. *Performing On-Farm Energy Audits*. ANSI/ASABE S612 JUL2009. St Joseph, MI.

6. American Society for Testing and Materials. 2012. *Standard Practice for Installation of Exterior Windows, Doors and Skylights.* ASTM E2112-07. Subcommittee: E06.51, Book of Standards, Vol. 04.12. West Conshohocken, PA.

7. International Code Council, Inc. 2011. *International Energy Conservation Code*. IECC-12. Country Club Hills, IL.

8. U.S. Environmental Protection Agency and U.S. Department of Agriculture. *ENERGY STAR*. http://www.energystar.gov/.